ANEURYSM OF THE ARCH OF THE AORTA: RUPTURE INTO THE SUPERIOR VENA CAVA.[1]

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The patient the subject of this report was admitted to St. Mary's Hospital, Philadelphia, October 19, 1905. He was an Irishman, aged fifty-four years, by occupation a weaver.

Previous History. He had typhoid fever forty years ago and rheumatism twenty-four years ago. He denies syphilis. His wife died a number of years ago, never having had any miscarriages. He drinks considerable whiskey, and was drunk two weeks before his admission to the hospital. His parents are dead, of unknown cause. He has five brothers and sisters living and well.

Present Illness. He was perfectly well until October 17, 1905 (two days before admission). At that time he noticed a sudden swelling of the face and arms, accompanied by cough and dyspnœa, which prevented him from lying down in bed. He had no pain. Before this attack he worked every day and never noticed any dyspnœa, œdema, or palpitation.

Examination on Admission. The patient suffers from orthopnœa. His face, both arms, neck, and upper chest, are swollen to twice their normal size, and are œdematous and markedly cyanosed. All of the superficial veins are greatly enlarged; some are as large as a crow-quill. The external jugular vein on the left side is dilated to the size of the index finger, and a branch of this vein crosses the superior part of the sternum and anastomoses with the mammary veins. The veins at the margin of the ribs form great varices; in places the chest is almost black from the number and size of these veins. The superficial veins over the left abdominal wall are slightly increased in size. The hands, the legs, and the genitals are not swollen. There is slight œdema of the abdominal wall. The heart dulness, as shown in Fig. 1 *A*, is about normal in size. The apex-beat is difficult to palpate and is quite irregular. The sounds at the aortic cartilage are clear and the second is accentuated. There is an indistinct "crunch" at the xiphoid. At the apex the first sound is weak and valvular and there is a very indistinct systolic murmur. No abnormal dulness is made out over the sternum. There were no murmurs in the vessels or at the root of the neck. The systolic blood pressure in the left arm is 189, in the right arm 160; diastolic pressure in the left arm 160, in the right arm 120. There is a slightly dull note at the apex of the right lung. There are no other abnormal percussion sounds. The breath sounds are normal throughout. There is no abnormality in the abdomen; neither the liver nor spleen can be palpated.

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[1] Read at the meeting of the Association of American Physicians, Washington, D. C., May 15 and 16, 1906.

October 22. Patient complains of great dyspnœa and troublesome cough. The cyanosis and œdema of the upper half of the body have increased. There is marked dulness on percussion under the first piece of the sternum, as shown in Fig. 1 *A.* No pulsation can be felt over this area or in the suprasternal notch. There is a slight systolic murmur over the dull area. Auscultation of the trachea does not develop compression of that organ. At the apex of the left lung the expiration is slightly prolonged. Tracheal tug cannot be developed. There is no pulsation over the area of dulness. A radiogram was taken and did *not* show the presence of an aneurysm.[2]

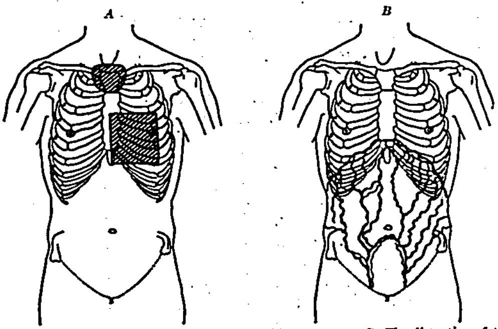

Fig. 1.—*A.* The area of heart dulness under the sternum. *B.* The distention of the abdominal veins.

23*d.* Patient has great distress upon swallowing, on account of the dyspnœa it causes.

25*th.* Laryngological examination shows venous engorgement of the mucous membrane, but no signs of pressure.

26*th.* Dulness over the first piece of the sternum still persists. There is no visible or palpable pulsation. At the junction of the first and second pieces of the sternum there is a marked to-and-fro murmur with a very sharp second sound. Pressure over the sternum causes great distress in breathing.

31*st.* The apex of the heart is far to the left of the nipple line. There are signs of pleural effusion in both chests. About one pint of bloody liquid was removed from the right chest. A marked dermatitis has developed in both arms.

November 12. The veins over the chest are more distended. No dulness can be made out over the manubrium, but the marked double murmur with a sharp second sound can be heard. It can also be heard in the back. There is marked distention of the abdominal veins.

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[2] This, of course, was because of the small size of the aneurysm, immediately under the sternum.

26th. The abdominal veins are greatly enlarged (Fig. 1 *B*). These veins anastomose with the greatly distended veins of the chest. There is no marked enlargement of the veins on the posterior part of the chest. The dulness over the sternum is marked. No thrill or pulsation can be felt. The same murmur, double in character, can be heard, with an accentuated second sound. There is no murmur in the veins of the neck.

The patient died suddenly on the morning of October 27. There were slight rises of temperature during the course of the disease. The urine was normal. The hemoglobin was diminished, but there were no other blood-changes.

Autopsy. The body is that of a middle-aged man. There is no œdema of the extremities. The superficial veins of the chest and abdomen are tortuous and considerably dilated. On removing the sternum the azygos veins are seen to be greatly distended. The right pleural cavity contains about 950 c.c. of cloudy amber fluid. The parietal veins are dilated. The left pleural cavity contains about 135 c.c. of cloudy amber fluid. The parietal veins are distended. At the apex of the right lung are a few healed scars; scattered throughout the upper lobe are numerous white areas, about the size of a millet-seed, which on section are seen to be miliary tubercles. In two or three places these tubercles are massed together and are beginning to caseate. The left lung is smaller than its fellow. The surface is of a very dark purple color. The lung is nowhere crepitant except at the anterior margin. The cut surface presents a firm, marbled appearance; the alveoli appear to be obliterated; on compressing the lung a white, purulent fluid exudes. At the apex there are several old, healed scars; there is no evidence of acute tuberculous involvement. A section of the lung sinks in water. The pericardial cavity contains about 50 c.c. of turbid amber fluid. The surfaces are smooth.

Heart and Aortic Arch. The heart lies in its usual position. It extends on the right about 5 cm. to the right of the median line. The displacement to the right is due to the immense effusion in the left pleural cavity. Just beneath the sternum, on a level with the third rib, extending from the second rib to the third interspace, there is an indefinite mass bound about by adhesions, but not attached to the sternum. The heart itself is approximately normal in size. The muscle is dark-red in color and somewhat decreased in consistency. The walls are thinner than normal: the right ventricle averages 1 mm. in thickness, the left ventricle about 10 mm.; the cavity is about normal in size. The leaflets of the tricuspid, pulmonary, and mitral valves are thin, delicate, and apparently normal. Two leaflets of the aortic valve contain a calcareous nodule at their bases which protrude into the sinus of Valsalva. They measure about 3 mm. in diameter; otherwise, these leaflets are thin and delicate. All the valves are apparently functionally intact. The circumference of the aortic ring is 7 cm. Scattered over the various portions of the arch, as well as of the thoracic aorta, are numerous atheromatous plaques, measuring from 2 to 17 cm. in their greatest diameter; none of them are actually calcareous. At a distance of 5.5 cm. from the aortic ring is a sacculated dilatation of the ascending part of the arch of the aorta, measuring 3.5 cm. in diameter (Fig. 2). This sac, which protrudes from the aorta on the right and slightly posterior, measures 3 cm. in depth, and is narrower than the greatest diameter of the aorta itself. The vena cava is constricted near the centre, where there is a small aperture about 7 mm. in diameter, and with a smooth edge, so that there is direct communication between the ascending aorta and the superior vena cava (Fig. 3). The aneurysmal sac distends the aorta at the origin of the innominate,

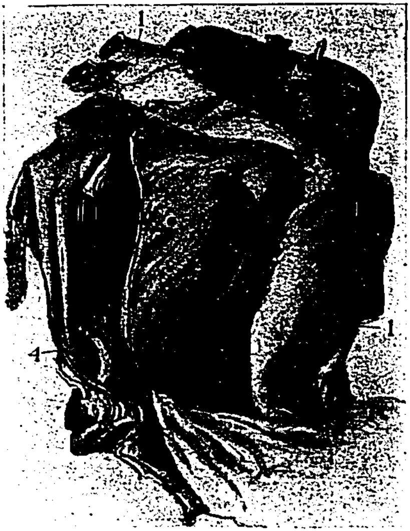

Fig. 2.—Exterior of the aneurysm, showing rupture into the vena cava; the vena cava laid open. 1. Aorta, exterior surface. 2. Adventitious sac filled with clot. 3. Vena cava laid open. 4. Opening from the sac into the vena cava.

but the aorta is apparently normal at the origin of the left carotid artery. The aneurysmal sac has ruptured downward and forward, and has formed an adventitious sac between the aorta and the superior cava. This adventitious sac has for its walls the ruptured aorta, the connective tissue surrounding the vessel, the superior cava, and the pulmonary artery. It measures from above downward 6.5 cm., and is approximately 3.5 cm. in diameter. It has compressed the superior cava 3 cm. above its entrance into the auricle, and has ruptured into the cava at this point. The opening into the cava is about 7 mm. in diameter and is elliptical in outline, the long axis of the ellipse being in the direction of the vessel. The true aneurysmal sac in the aorta is entirely free from clot, but the adventitious sac is filled with a firmly organized coagulum. The blood has forced its way between the adventitious sac wall and the organized clot. It is seen from this that the actual rupture of the true aneurysmal sac must have occurred at a time antedating the symptoms, but the rupture from the adventitious sac into the cava doubtless occurred at the onset of the symptoms.

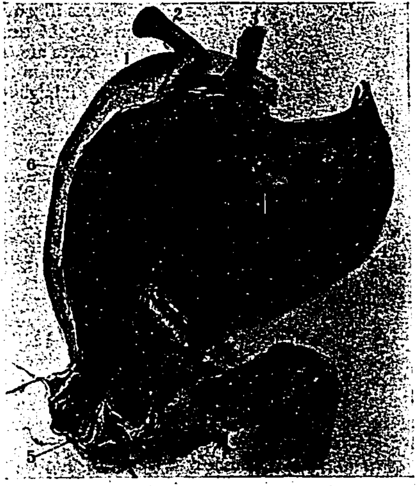

FIG. 3.—Interior of the aorta, showing the aneurysm. 1. Innominate artery. 2. Left carotid artery. 3. Left subclavian artery. 4. Aorta. 5. Aortic valves. 6. Aneurysm with clot at the bottom.

The liver weighs 1150 grams and measures 20 x 17 x 6 cm. The surface is smooth, free from adhesions, and of a dark purplish color. Near the falciform ligament on the surface of the left lobe is a hard, calcareous nodule, about 5 mm. in diameter. The cut surface is brownish red in color. The central veins are clearly seen and are surrounded by a paler area of a light-brown color. Glisson's capsule is not increased. The consistency of the organ is diminished and the organ may be readily torn. The gall-bladder is normal. The spleen weighs 50 grams and measures 6 x 7 cm. The bloodvessels project above the surrounding pulp. There is a slight increase in the trabeculæ.

The right kidney weighs 105 grams and measures 10 x 6 x 2.5 cm. The left kidney weighs 95 grams and measures 6 x 2.5 cm. Their capsules strip with difficulty. The external surfaces are of a dark purplish color. On section the cortex averages 7 mm. in thickness. The consistency of the organs is increased. The Malpighian bodies are not visible.

The pancreas, stomach, and intestines are apparently normal. There is moderate atheroma, with a few calcareous plates in the abdominal aorta. The walls of the urinary bladder are somewhat thickened and congested.

Histological Examination. Heart. The epicardium is wanting. The endocardium is apparently normal. Interstitial connective tissue is not increased. Fragmentation of the muscle fibers is very marked in some places, less so elsewhere. Polar pigmentation is very marked, every fiber giving evidence of it. The capillaries are slightly thickened. The striæ of the muscle fibers are preserved.

Liver. The external capsule and the capsule of Glisson are apparently of normal thickness. All the capillaries are more or less engorged with blood cells, but especially the intralobular veins. The bile ducts are normal. In many places the columns of liver cells are farther apart than usual, and in spaces thus left red blood corpuscles are to be seen. Many of the hepatic cells are filled with a brown pigment. Those surrounding the terminals of the hepatic vein are especially rich in pigment granules, while the cells in the periphery are often quite free of them. The nuclei of the cells take a deep-blue color with hematoxylin.

The rarity of this rupture of an aortic aneurysm into the superior cava may be judged by some figures by Kelynack.[3] He reports 4593 cases of aneurysm of the arch of the aorta with rupture in thirty-two cases, or 6.9 per cent. Of these, one was into the superior cava. Therefore, one would have to see in the neighborhood of 5000 aneurysms before observing a rupture into the superior cava Two cases similar to the one here reported have been presented to this Association (Pepper and Griffith[4] in 1890, and Stengel[5] in

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[3] Lancet, 1897, ii, 193.

[4] Trans. Assoc. Amer. Phys., 1890, v, 45.

[5] Ibid., 1900, xv, 532.

1900). Thus three out of five of reported American cases have been reported before this Association.

Pepper and Griffith collected all the cases of rupture into the vena cava which had been reported previously, in all, twenty-nine cases. I am now able to add seven more cases, those reported by Ord,[6] Mercudino,[7] Bruce,[8] Stengel, Rendee,[9] Leyden,[10] and my own, making a total of thirty-six cases. Careful review of these thirty-six cases leads to a confirmation of the thorough and exhaustive analysis which Pepper and Griffith made of their cases sixteen years ago. The chief points were: The sudden cyanosis, œdema, and distention of the veins of the face, neck, arms, and upper half of the trunk. The picture is so striking that once seen it can never be forgotten. The picture is almost grotesque, so great is the disparity in size and appearance between the upper and the lower halves of the body. It was my fortune to see during life the case reported by Pepper and Griffith, and while the condition had not again been brought to my mind, I was able at once to recognize my case as one of this character when first seen.

The murmur so accurately described by Pepper and Griffith, the continued high-pitched murmur with increase during systole and general decrease in intensity during the diastole, has been present in sixteen of the thirty-six cases reported. A to-and-fro murmur is described eight times, systolic six times, diastolic once, and is not mentioned five times. The symptoms and sings of an aneurysm in the chest, of course, make the diagnosis much more easy and certain.

Thirteen of the thirty-six patients gave the history of being entirely well before the symptoms of rupture; but at autopsy twenty-nine of the cases were shown to have tumors as large or larger than an orange, and therefore were probably susceptible of a diagnosis of aneurysm at or before the rupture, had the point been given attention, —although, as Osler has pointed out, there are cases of aneurysm with symptoms but without physical signs, and aneurysms with signs but without symptoms. All of the symptoms and physical signs of rupture into the cava may, however, be simulated by pressure upon the cava, as proved by the following case reported by Salomon.[11]

A man was admitted to the Hospital Laënnec, April 24, 1903. On a certain night this individual was heard making noises in his room. No attention was paid at the time. In a few hours he was found unconscious and taken to the hospital. He was comatose. There was an intense cyanosis of the face, neck, and arms. There was little œdema. There was a continuous murmur over the base of the heart, with intensification during systole and diastole. There were signs of aneurysm of the arch of the aorta. On account of the peculiar cyanosis and rapid onset a diagnosis of aneurysm rupturing into the cava was made. At the autopsy an aneurysm of the ascending portion of the arch was found. The right side of the sac was in connection with the vena cava superior. Careful examination of the vena cava and of the aneurysmal sac failed to show any communication between the two. There was no thrombosis in the vena cava.

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[6] Brit. Med. Jour., 1891, i, 407; Trans. Path. Soc. London, 1891, xlii, p. 71.

[7] Gaz. Med. di Torino, 1893, xlii, 517.

[8] Edin. Med. Jour., 1985, xl, 896.

[9] Sem. méd., 1900, xx, 151.

[10] Deut. med. Woch., 1904, i, 601.

[11] Bull. et mém. Soc. anat. de Paris, 1903, vi, 463.

The murmur described is simulated by the murmur caused by a rupture between an aneurysm and the pulmonary artery, as proved by cases reported by Clarke[12] and Kaufmann,[13] but in these cases there is not the characteristic cyanosis of the face, head, and chest. Cases are reported of a tumor making gradual pressure on the vena cava in which nearly the same physical signs exist, excepting the murmur. In his case, too, Goldflam[14] says the symptoms came on slowly.

The diagnostic signs, then, of rupture of an aneurysm into the superior cava are: (1) A sudden cyanosis, œdema, and dilatation of the veins of the face, head, neck, arms, and chest. (2) A peculiar, continued, high-pitched murmur, present in about half the cases. (3) The physical signs of an aneurysm of the aorta. A very probable diagnosis of the condition may be made on the first sign alone.

A STUDY OF THE DIFFERENT FORMS OF ALBUMIN OCCURRING IN THE URINE.

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STRICTLY and correctly speaking the term albuminuria may be limited by some to the excretion of albumins in the urine through the renal tissues; but if the term is considered as applied almost universally it relates to the finding of an albumin in the urine excreted from the bladder. We have accepted the second conception as the basis for this article, which deals with over 5000 examinations of specimens, many of which were sent to the laboratory with the statement that albuminuria was present and with the request to interpret this condition. It has been found that the large majority

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[12] Brit. Med. Journ., 1900, ii, 1701.

[13] Wien. klin. Woch., 1905, xviii, 1004.

[14] Méd. mod., 1892, iii., 416.